Supplemental Document

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Development and evaluation of a wearable peripheral vascular compensation sensor in a swine model of hemorrhage: supplement

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DEVELOPMENT AND EVALUATION OF A WEARABLE PERIPHERAL VASCULAR COMPENSATION SENSOR IN A SWINE MODEL OF HEMORRHAGE: SUPPLEMENTAL DOCUMENT

Supplemental Methods

Custom optical flow phantoms were created using an Elegoo Saturn S MSLA 9.1" 4K mono LCD resin-based 3D printer and translucent ABS-Like Photopolymer resin (Elegoo, Shenzhen, China). The optical phantom was designed as a CAD model in Fusion 360 (Autodesk, San Rafael, CA) to be a rectangular solid with 20 mm length and 10 mm width and height. A 1.6 mm diameter horizontal channel was modeled lengthwise through the phantom, centered and 2 mm from the top face. The CAD model underwent slicing via ChituBox V1.9.3 for printing. To ensure that the channel did not collapse during the print, the 3D print was paused in the middle of the print process, at which time the phantom consisted of a rectangular solid with a cylindrical groove at the top of the print. Then a 1.45 mm diameter (15 American Wire Gauge, or AWG) wire was placed along the groove and secured tightly around the build plate. The wire used was slightly smaller than 1.6 mm to allow tolerance for channel shrinkage (allowing the channel to form around the wire) and to protect the LCD screen of the printer from coming into direct contact with the wire. The wire insertion process occurred quickly to reduce the risk of layer separation due to the resin cooling, and a heat gun warmed the resin before resuming the print with the wire in place. After printing, the wire was cut from the build plate and pulled out gently from the print. The model was then rinsed in ethanol and post-cured in a UV station for 1 minute facing upward and 1 minute facing downward.

Supplemental Figures

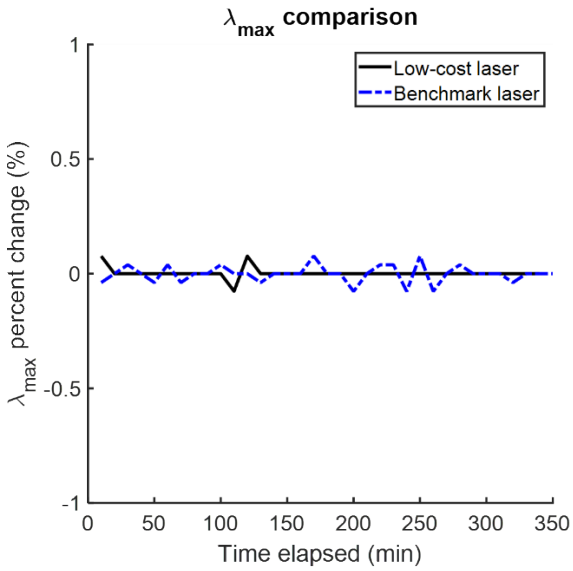


Figure S1. *Percent change of peak wavelength in low-cost and benchmark laser.*

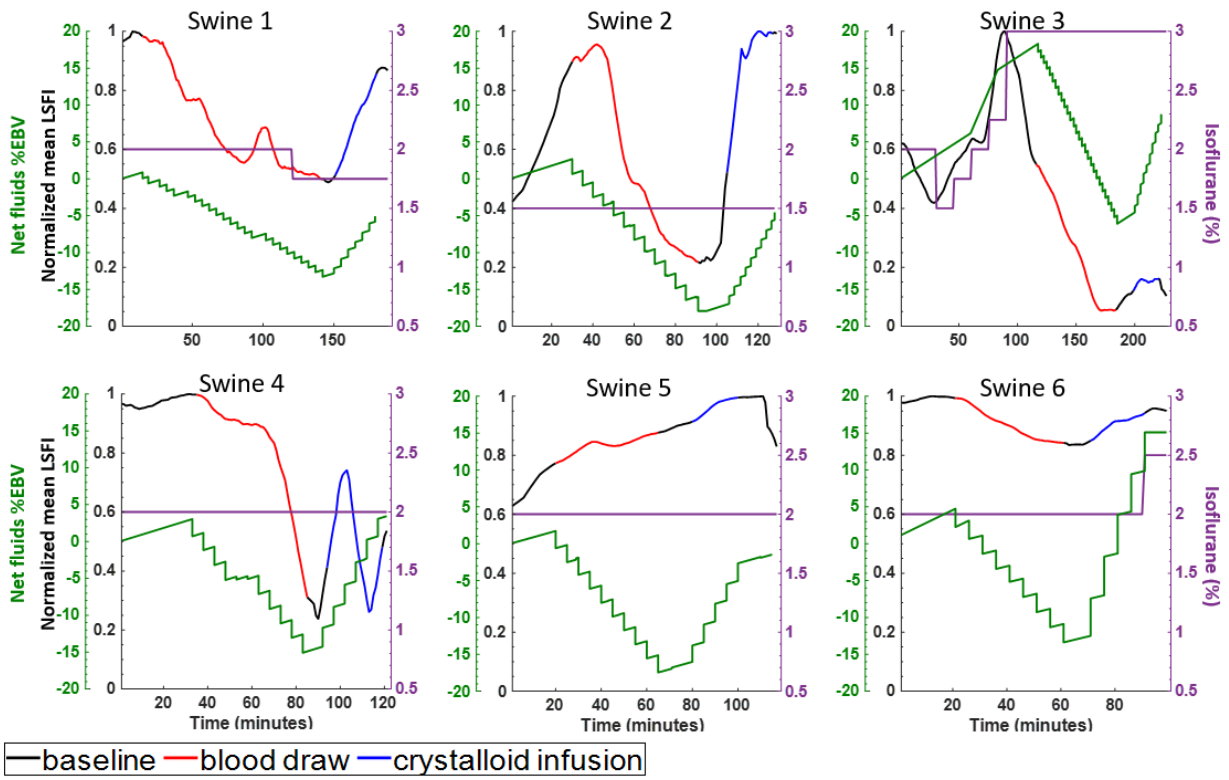


Figure S2. *Peak-normalized LSFI signal with net fluids and isoflurane dose overlaid.*

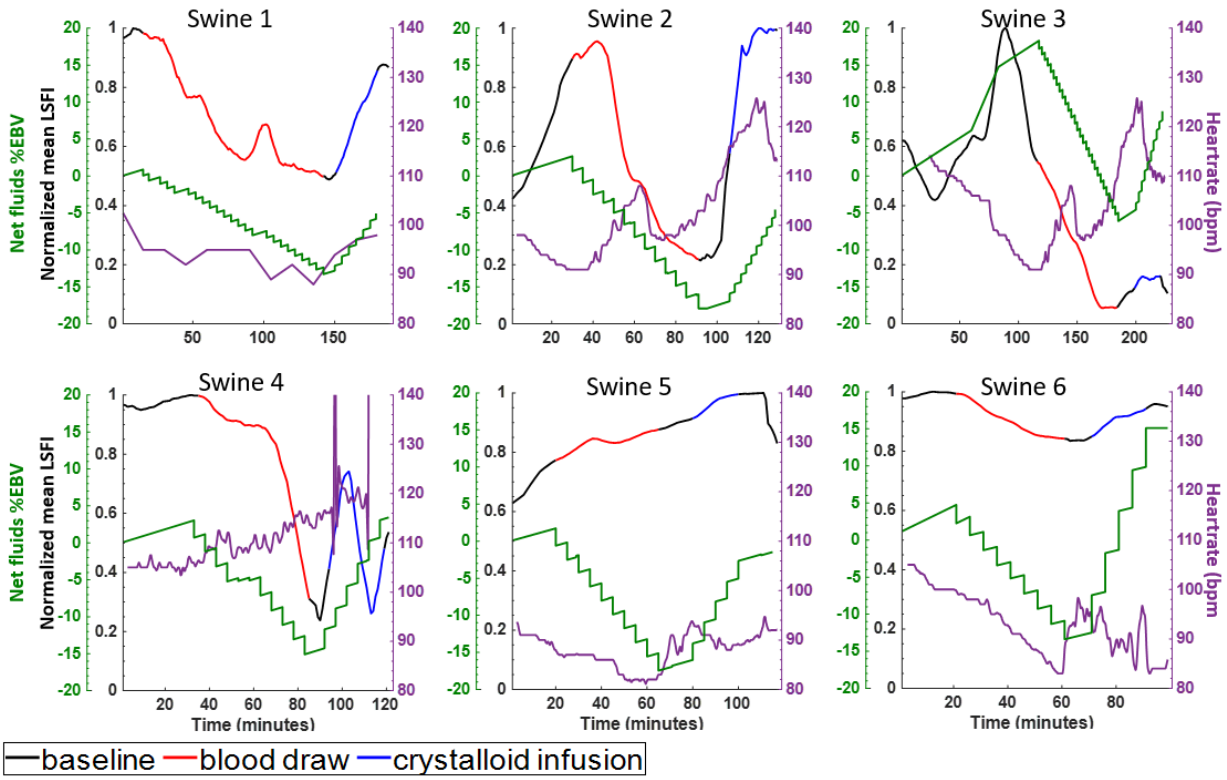


Figure S3. *Peak-normalized LSFI signal with net fluids and heart rate overlaid.*

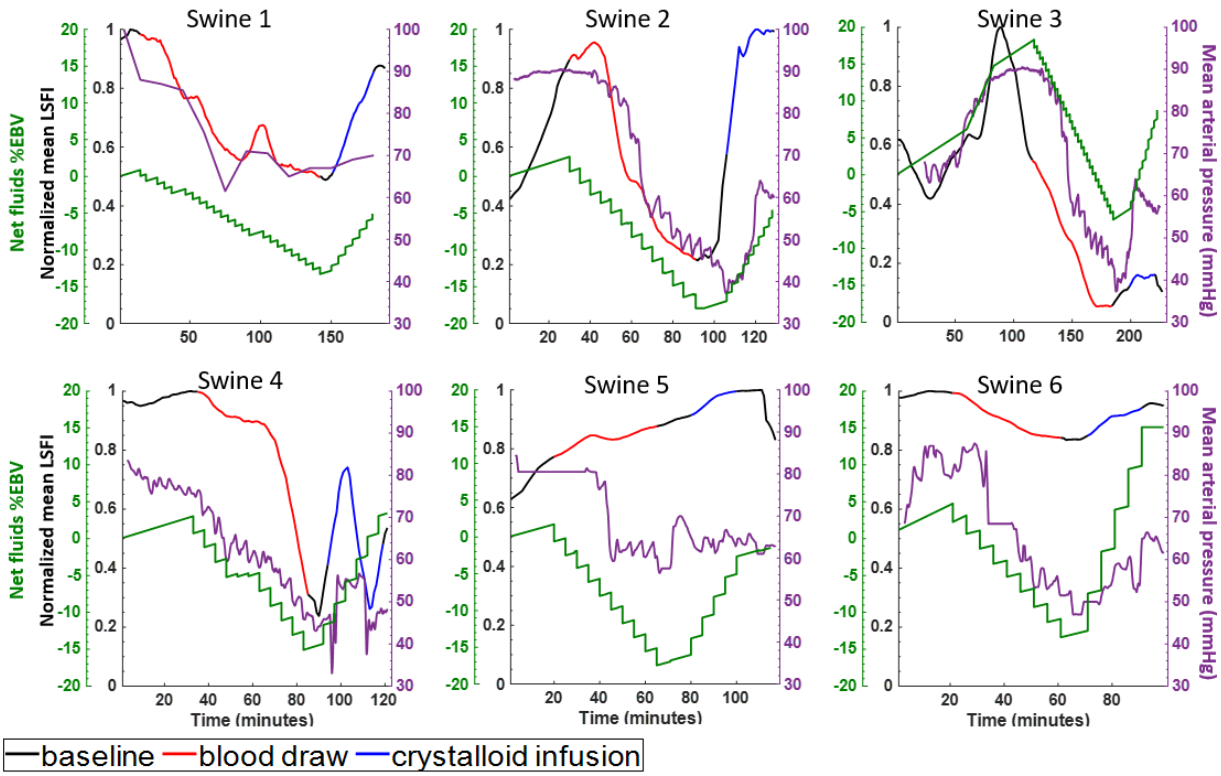


Figure S4. *Peak-normalized LSFI signal with net fluids and mean arterial pressure overlaid.*

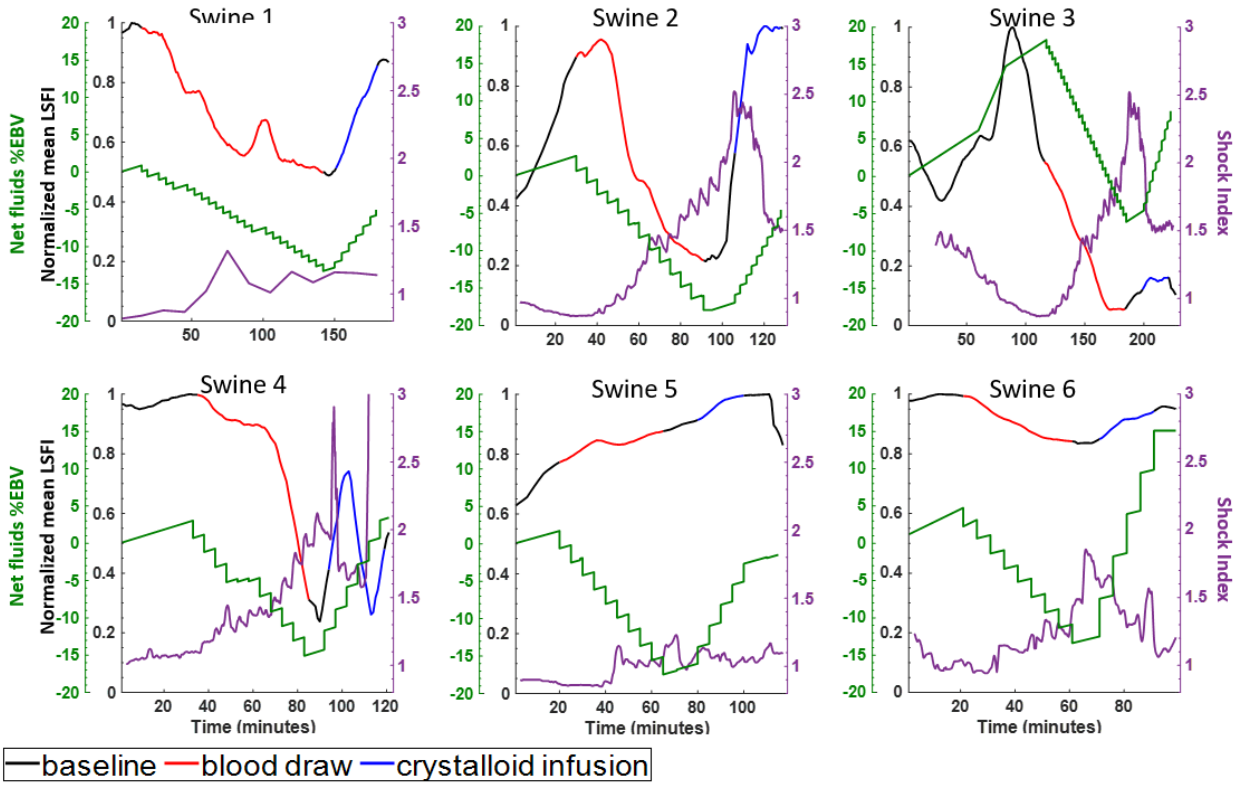


Figure S5. *Peak-normalized LSFI signal with net fluids and Shock Index overlaid.*

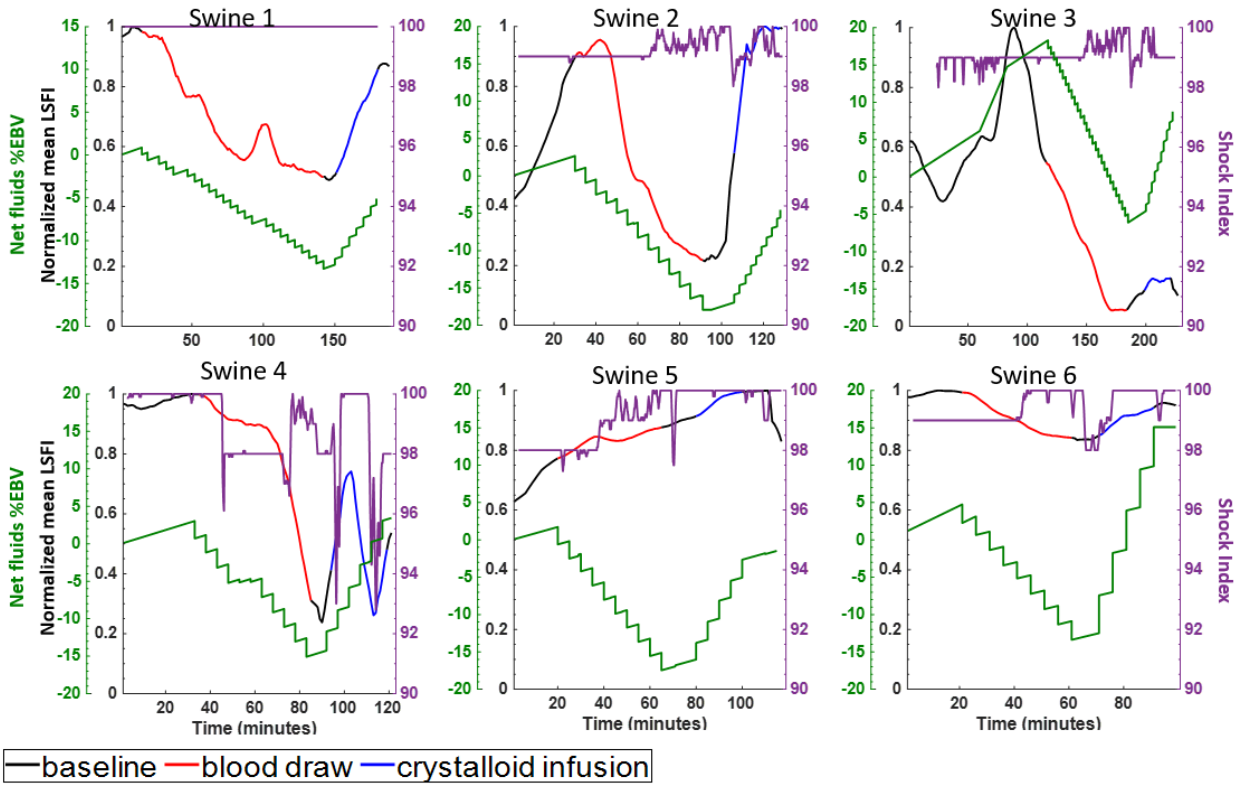
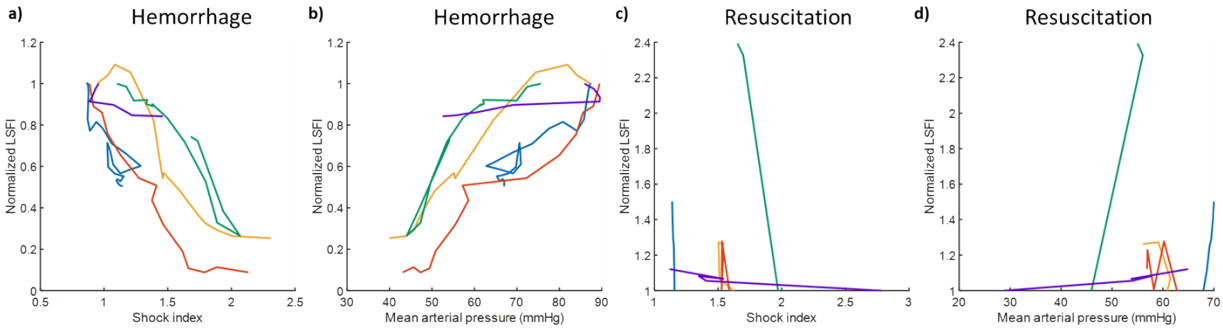


Figure S6. *Peak-normalized LSFI signal with net fluids and blood oxygen saturation (SpO_2) overlaid.*

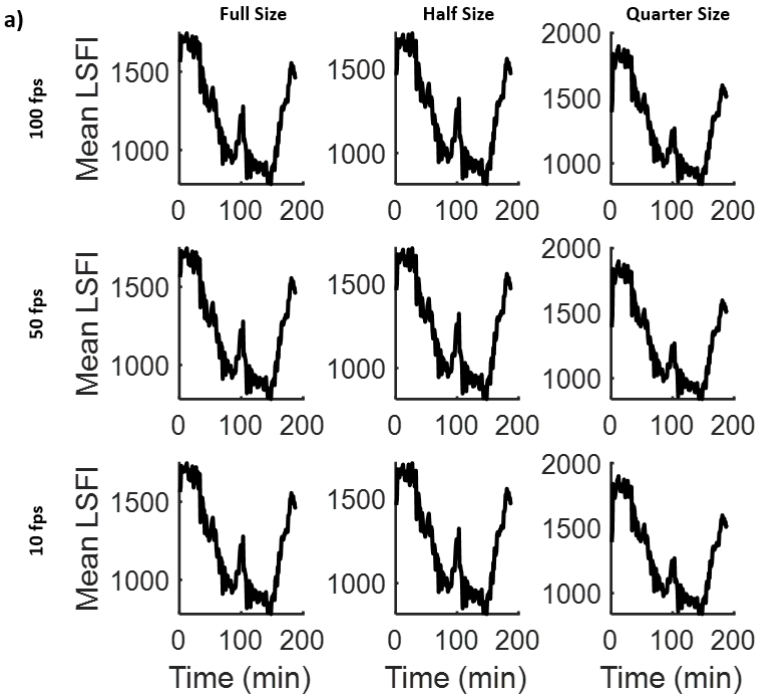


e)

		Swine 1	Swine 2	Swine 3	Swine 4	Swine 6	Average
SI vs. LSFI	r	-0.8355	-0.9310	-0.9567	-0.9567	-0.8005	**-0.8953**
Hemorrhage	slope	-1.0407	-0.7559	-0.8084	-0.7848	-0.2410	-0.7262
MAP vs. LSFI	r	0.9356	0.9715	0.9736	0.9736	0.8810	**0.9329**
Hemorrhage	slope	0.0173	0.0192	0.0181	0.0233	0.0032	0.0162
SI vs. LSFI	r	0.9725	-0.7985	-0.4433	-0.9960	-0.9185	**-0.7938**
Resuscitation	slope	-24.1312	-0.4256	-2.2006	-4.5268	-0.0618	-6.5236
MAP vs. LSFI	r	0.9847	0.3880	-0.3156	0.9906	0.9625	**0.3603**
Resuscitation	slope	0.2315	-0.0088	-0.0160	0.1404	0.0031	0.0621

Figure S7. *Comparison of SI vs. normalized LSFI and MAP vs. normalized LSFI during hemorrhage (a-b) and resuscitation (c-d). Summary of correlation coefficients and slopes for each linear correlation.*

a)



b)

	Full size	Half size	Quarter size
100 fps	-0.88	-0.88	-0.88
50 fps	-0.88	-0.88	-0.88
10 fps	-0.90	-0.90	-0.90

c)

	Full size	Half size	Quarter size
100 fps	0.99	0.99	0.98
50 fps	0.99	0.99	0.98
10 fps	0.99	0.99	0.98

Figure S8. *Effects of sampling rate and frame size on mean LSFI signal in swine 1 (a) and comparison of correlation coefficients during hemorrhage (b) and resuscitation (c) at each sampling constraint*

Table S1. *Power consumption of device performing various tasks related to data capture and processing; voltage held constant at 5 V.*

Task	Current (mA)	Power (W)
Booting up	205	1.0
Device idle waiting for Bluetooth connection	110	0.5
Device connected waiting for user input	170	0.8
Device connected powering on laser	280	1.4
Device connected recording video	240	1.2
Device connected, processing data, and sending to client	335	1.7
Device connected, recording video, and powering on laser	300	1.5
Device connected, processing data, sending data to client, and powering laser on	410	2.0